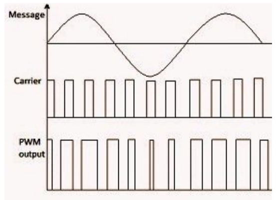
PsychoTronics

No. 1
Amplifiers and Oscillators
www.asmrstudio.com

The "Chopper" Amplifier and Pulse Width Modulation

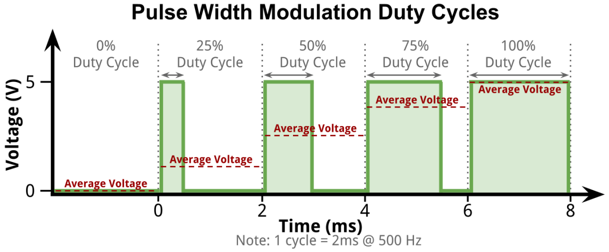
A signal gained, also amplifies background noise. One solution is to "chop" an incoming DC signal using pulse width modulation, and output an amplified AC signal. The 555 is a "chopper" thus a nonlinear amplifier. Also known as switching amplifiers (D to T-Class Amplifiers), these differ from linear gain devices (A to C-Class Amplifiers) that have lower distortion levels. electronics-tutorials.ws/amplifier/amplifier-classes.html

In Direct Current (DC) Magnetic Motors, Light Emitting Diodes and Radio, the voltage variance determines pulse and frequency. Normally a variable resistor is used, but to avoid energy loss as heat, Pulse Width Modulation (PWM) supplied by an oscillator is used. The average voltage delivered to the load is controlled by varying the rectangular wave duty cycle.

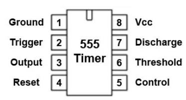


Low Voltage = Quick Pulse, High Voltage = Long Pulse

Pulse Width Modulation Duty Cycles



555 SOUND AMPLIFIER CIRCUIT

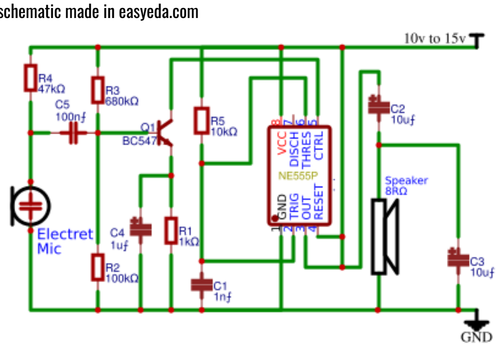


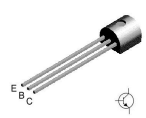
555-timer-circuits.com/555-amplifier.html

The resistors (R) and capacitor (C) cause the 555 timer to oscillate at approx 66kHz. The speaker does not respond to this high frequency. Instead it responds to the standard modulated output from a 20kHz Compact Disc Line out, demonstrating the concept of pulse-width modulation. Amplifier gets very hot and is for brief demonstrations. Heat sink may be useful.

66 Hertz Per Second = 1.44 / (R1+2R2) * C

schematic made in easyeda.com





Q : BC547 NPN (C,B,E)

C : Polar Capacitor +/-

R : Resistor (Oxide Film)

C : Non Polar Capacitor (Ceramic Disc)

Build a Capacitor from Aluminum Paper and a Book

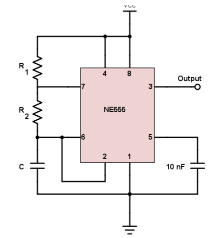
archive.org : tinyurl.com/yynsbh45

Capacitor is two aluminum sheets tucked into a book, with one page separating them. Capacity is reduced by sliding one strip out from the book a little at a time. Capacitance changes when you press down on the book, or when days are humid. With more effort, a durable, stable, capacitor using foil and waxed paper or plastic wrap is possible.

Parallel Capacitors = $\mathbf{C_P = C_1 + C_2 + C_3}$ Capacitors in Series = $\mathbf{C_S = 1/C_1 + 1/C_2 + 1/C_3}$

555 Timer Calculations

allaboutcircuits.com/tools/555-timer-astable-circuit/



The 555 timer shown right, in an astable circuit.

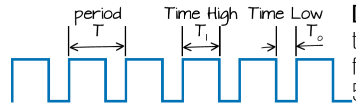
Frequency Hz (Hertz) is pulses per second.

F = 1.44 / (R1+2R2) * C

Wavelength λ (Period) is the time in seconds covered for one pulse. **T= 1 / f = 0.694 * (R1+2R2) * C**

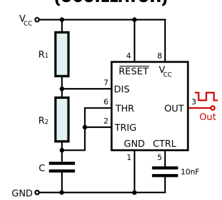
High Time (T1) and **Low Time** (T0) calculations. Note that the period is the sum of the high time and low time. **T1 = 0.694 * (R1+R2) * C** **T0 = 0.694 * R2 * C**

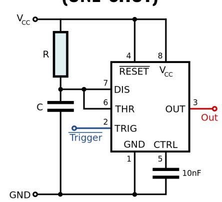
Mark Space Ratio is the ratio between the high and the low time or: **T1 / T0**

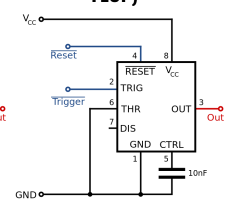


Duty Cycle is more commonly used than the mark space ratio. Formula for duty cycle is: **(T1 / T) x 100** A 50% duty cycle means the high time is equal to the low time. An LED placed at output (Piun 3), will be on the same length it is off. Note that **Notes: 1.** Increase C to increase the period (reduce the frequency). **2.** Increase R1 to increase High Time (T1), without affecting the Low Time (T0). **3.** Increase R2 to increase High Time (T1), increase Low Time (T0) and decrease the duty cycle. **4.** Getting an exact 50% duty cycle is impossible with this circuit.

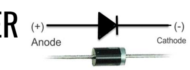
ASTABLE 555 TIMER (OSCILLATOR) **MONOSTABLE 555 TIMER (ONE-SHOT)** **BISTABLE 555 TIMER (FLIP FLOP)**







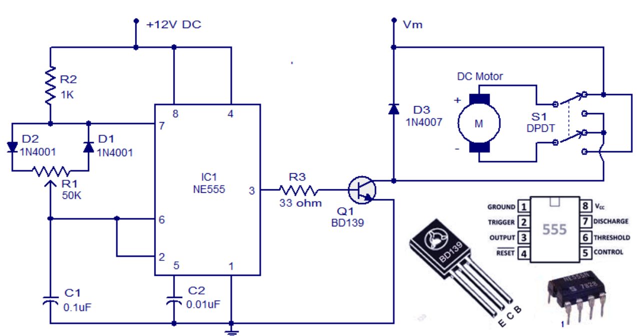
555 DC MOTOR CONTROLLER



D : Schottky Diode 150–450 mV Forward Voltage SemiConductor

circuitstoday.com/dc-motor-controller

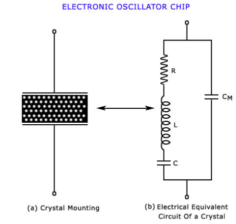
NE555 is wired as an astable multivibrator whose duty cycle (motor speed) can be adjusted by varying the POT R1. The output of IC1 is coupled to the base of transistor Q1 which drives the motor according to the PWM signal available at its base. Change of DC motor direction is attained using the DPDT switch S1 which toggles the polarity applied to the motor.



Use 12V DC for powering the IC. Vm is the power supply for motor and its value depends on the motor voltage rating. Vce (Voltage from Collector to Emitter) for BD139 is 80V, so Vm should not exceed 80 volts. Maximum collector current BD139 can handle is 1.5A and so do not use a motor that consumes more than 1.5 amperes of current. A heat sink is necessary for BD139.

Crystal (xtal) Oscillator

circuitdiagramworld.com :: tinyurl.com/y4t3u5c6

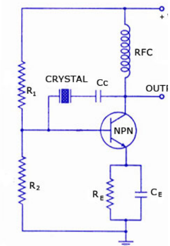


When a mechanical pressure is applied across the crystal faces, a voltage proportional appears across the crystal, properly known as piezo-electric effect. Conversely, when a voltage crosses the crystal surfaces, the crystal distorts proportionally. A/C vibrates xtal at its natural frequency. Quartz, Rochelle salt exhibit piezo-electric effect the greatest, are mechanically the weakest strongly affected by moisture and heat. Its applications are limited to Microphones, headsets and loudspeakers. Tourmaline is rugged showing the least piezo-electric effect. Quartz is somewhere in between salt and tourmaline. Crystals behave as a series (Resistor-Inductor-Capacitor) R-L-C circuit in parallel with C_M where C_M is the mounting electrodes capacitance (empty crystal mount). Because the crystal losses, represented by R, are small, the equivalent crystal Q is high-typically 20,000. Q values upto 10^6 are obtained by crystals. Crystal has two resonant frequencies due to C_M. Physically, Q is 2π x (energy stored / energy lost) per cycle or equivalently the ratio of the stored energy to the energy dissipated over one radian of the oscillation.

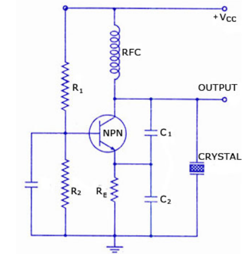
Series Resonant Frequency

$$f_s = ½ \pi \sqrt{LC}$$

L = Inductor, C = Capacitor



In this mode of operation, generally called the Pierce crystal, impedance is smallest and positive feedback is the largest. Resistor R1, R_2 and R_E provide a voltage-divider stabilized dc bias circuit, the capacitor C_E provides ac bypass of the emitter resistor R^ and the radio-frequency coil (RFC) provides for dc bias -while decoupling any ac signal on the power lines from affecting the output signal. The voltage feedback signal from the collector to the base is maximum when the crystal impedance is minimum (that is, The series-resonant mode). The coupling capacitor C_c has negligible impedance at the circuit operating frequency and blocks any dc between collector and base. Crystal resonance in series sets circuit oscillation frequency.

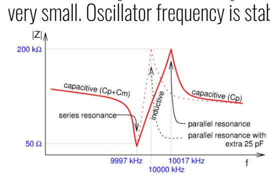


Parallel Resonant Frequency

$$f_p = ½ \pi \sqrt{[1 + C/C_M]} / LC$$

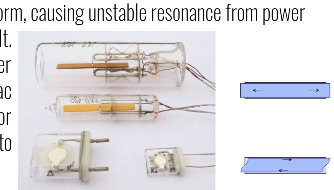
In this case crystal impedance is very high. Parallel resonance frequency f_p is due to xtal parallel capacitance C_M resonance and the reactance of the series circuit.

It appears that f_p is higher than f_s but the two frequencies are close due to C/C_M ratio being very small. Oscillator frequency is stabilized, by either its series or parallel resonant frequency.



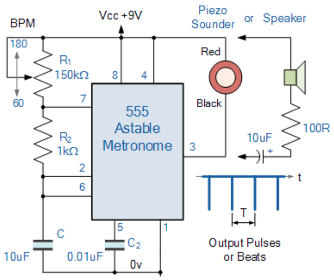
Crystal operating mode is low impedance in the series-resonant or high impedance in the anti-resonant or parallel resonant. Variations in supply voltage, transistor parameters, etc. have no effect on the circuit operating frequency held stabilized by the crystal. Crystal oscillators provide specified frequencies by a load capacitance listed by the manufacturer. Exceeding manufacturers power supply maximum ratings distorts the oscillators waveform, causing unstable resonance from power Loss as heat. Thin-plated electrodes may melt. Crystal resistance and a/c maximum drive power (varies from 2 m W to 10 m W) will determine ac voltage until detabalization and heat loss for plated crystals. P = V^2/R. One way may be to rubber band a xtal sliver to wires.

pa3fwm.nl/technotes/tn13a.html



Radio mounted quartz with piezo deformation

Would you like to know more? www.asmrstudio.com DrDoubleDragon@gmail.com

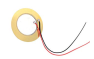


555 Tone Generator

allaboutcircuits.com : tinyurl.com/y334g69g

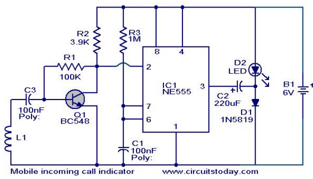
A 150kΩ pot (R1) adjusts the tone frequency. Present the output's upper and lower limits by adding resistors (a.k.a trimmers, pots, potentiometers or digipots) in series with the potentiometer (R1).

R1 Position	Beats per Minute
142.3kΩ	60 bpm
94.2kΩ	90bpm
70.1kΩ	120 bpm
55.7kΩ	150bpm
46.1kΩ	180bpm



Piezo Sounder Ceramic/Metal

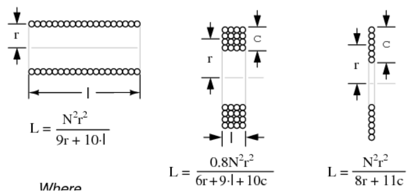
Mobile incoming call indicator <u>circuitstoday.com</u> : tinyurl.com/yysaqojd



The coil L1 is 10 μH and can be made on a 5mm dia plastic former, making 150 turns using 36 SWG enameled copper wire. Powered from a 6V battery. C1 & C3 are polyester capacitors. The electrolytic capacitor C2 must be rated at least 10V. The Light Emitting Diode (LED) placed near a mobile phone, even if the ringer is deactivated, lights. The receiver frequency is around 900MHz. Coil L1 picks up these oscillations by induction and feeds it to the base of Q1. This activates transistor Q1. Since Q1's collector is connected to IC1's pin 2 (NE555) , IC1 is triggered to make the LED connected at its output pin (pin 3) to blink. The blinking of the LED is the indication of incoming call.

Wheelers (Round Wire) Inductance Formulas

Air core radio to magnetic inductance formulas. Solenoid accurate to approximately 1% for 2r/l < 3. Thick coil is 1% accurate nearing equal denominators. Spiral formula is 1% accurate for c>0.2r.



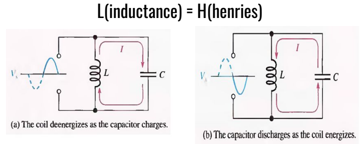
$L = \frac{N^2 r^2}{9r + 10l}$ $L = \frac{0.8N^2 r^2}{6r + 9l + 10c}$ $L = \frac{N^2 r^2}{8r + 11c}$

L = Coil Inductance in Microhenrys
N = Wire Turns
r = Coil in Inches Mean Radius
l = Coil Length in Inches
C = Coil Thickness in inches

Tank Circuits : From Battery Chargers to Crystal Oscillators

Circuit stores energy in the form of electric and magnetic fields, so it is a tank (storage). Inductor stores magnetic field energy and capacitor stores electric field energy. Inductor and capacitor play catch-catch energizing and de energizing.

L(inductance) = H(henries)



(a) The coil deenergizes as the capacitor charges. (b) The capacitor discharges as the coil energizes.

Electromagnetic OHM Ω Law (Theory)

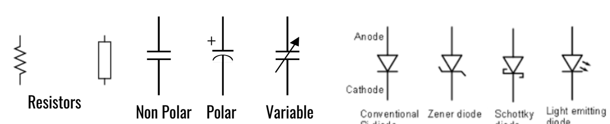
I (Amps)	= V/R	= P/V	= √P/R
V (Volts)	= I*R	= P/I	= √P*R
R (Ohm)	= V²/P	= P/I²	= V/I
P (Power)	= V*I	= R*I²	= V²/R

Sound (Theory)

V (velocity)	= Pa/z	= J/Pa	= √J/z
Pa (Pascals)	= v*Z	= J/v	= √J*z
Z (Impedance)	= Pa²/J	= J/v²	= Pa/v
J (Intensity)	= v*Pa	= Z*v²	= Pa²/z

Pascals (Pa) is System International (SI) pressure unit. 1 Pa = 1 newton per square metre. Volt is the SI electromotive force unit.

LIGHT SPEED = 186,282 km/s or 670,616,629 mph

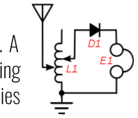


Would you like to know more? <u>www.asmrstudio.com</u> DrDoubleDragon@gmail.com

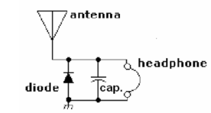
The Black Stone - Rock Set in Kaaba, at the Grand Mosque in Mecca, Saudi Arabia

Islam makes pilgramidge to a rock. Yes, it's probably ornamental as the original stone was probably put to work. Nasa is busy growing space crystals free from gravity's influence as the ones from meteorites are perfect. **nasa.gov/pdf/675572main_Science%20Activity-SOS.pdf**

Long-Distance Survival Radios survival.org.au/radio.php



A capacitor blocks low frequencies and allows high frequencies to pass. A coil (inductor) passes low frequencies and blocks high frequencies. By using both high and low frequencies are blocked and only narrow range frequencies are allowed to pass. This will have the effect of selecting a particular radio frequency. This is known as a tuned circuit. Because in our radio the capacitor is variable, it's value (technically called its capacitance) will change as you turn the knob, which means the exact frequency that is allowed to pass through can be changed so you can tune in a radio station Headphones are crystals.



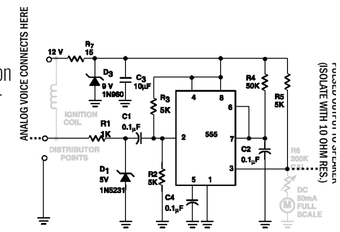
dartmouth.edu : tinyurl.com/y48olvej

1973 VOICE TO SKULL

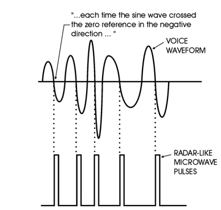
cultocracy.wordpress.com : tinyurl.com/yyqc7bt3

Artificial microwave voice to skull transmission was successfully demonstrated by researcher Dr. Joseph Sharp in 1973, announced at a seminar from the University of Utah in 1974, and in the journal "American Psychologist" in the March, 1975 issue, article title "Microwaves and Behavior" by Dr. Don Justesen. Image illustrates voice to skull modulation method described in the American Psychologist journal article. The 555 chip is rated to work the 100KHz range. Microwaves have wavelengths approximately in the range of 30 cm (frequency = 1 GHz) to 1 mm (300 GHz). National Telecommunications and Information Administration generally divides the radio spectrum into nine bands:

Extremely Low Frequency (**ELF**) <3 kHz >100 km
Very Low Frequency (**VLF**) 3 to 30 kHz 10 to 100 km
Low Frequency (**LF**) 30 to 300 kHz 1 m to 10 km
Medium Frequency (**MF**) 300 kHz to 3 MHz 100 m to 1 km
High Frequency (**HF**) 3 to 30 MHz 10 to 100 m
Very High Frequency (**VHF**) 30 to 300 MHz 1 to 10 m
Ultra High Frequency (**UHF**) 300 MHz to 3 GHz 10 cm to 1 m
Super High Frequency (**SHF**) 3 to 30 GHz 1 to 1 cm
Extreme High Frequency (**EHF**) 30 to 300 GHz 1 mm to 1 cm



A 555 chip tachometer driver circuit to simulate dr.joseph sharp's microwave voice to pulses conversion method

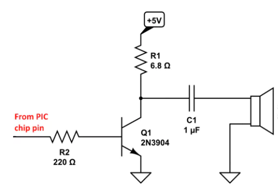


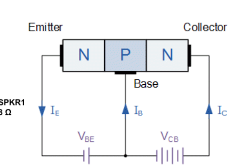
Voice conversion to pulses, as used in the successful demonstration of microwave voice-to-skull technology in 1973 by dr. Joseph Sharp. This is not classified.

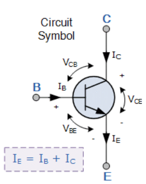
Jesse Ventura tests V2K (voice to skull) on himself : youtube.com/watch?v=i5cHDOB-93A

2N3904 NPN Transistor (Emitter, Base, Collector)

electronics-tutorials.ws/transistor/tran_2.html

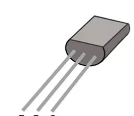




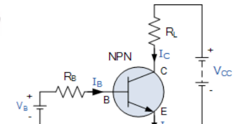


E = Emitter
B = Base
C = Collector

Vce = 40v Max Hz = 300MHz
Ic = 200mA
P = 625mW



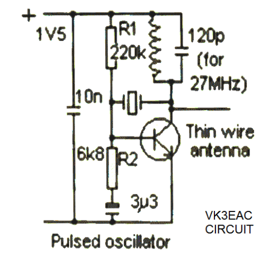
digikey.com



RADIO BEACON "PIERCE" CRYSTAL (xtal) OSCILLATOR

www.vk6fh.com/vk6fh/beacon simple circuit.htm

Simple, single transistor, Quartz controlled, low-pwr, pulsing radio beacon. An RC network has been added b/w transistor base and gnd. This RC network and the base-emitter junction seems to gate the transistor on and off; thus becoming a keyer-cct for the oscillator!



I had to place 100pF b/w Collector and Gnd to get it "pulsing" Seems to only oscillate with fundamental mode, parallel resonant crystals? Some series mode "overtone" xtals I have, wouldn't "hoot" at all in this design. Tried a resistor as collector load, but wouldn't oscillate. Seems you have to use a resonant parallel LC at the collector. (or maybe an RF Choke). I used a 1.2V 1600mAH Ni-MH cell. Current drain key-down; 2mA (2.5mW) Cell should last a long time! I tried raising the voltage to 5V, to increase RF o/p but circuit refused to pulse!?

Rochelle salt crystals Ingredients

500 grams (1 lb) of baking soda (sodium bicarbonate, $NaHCO_3$),
200 grams (7 oz) of cream of tartar (potassium bitartrate, $KHC_4H_4O_6$),
250 milliliters (1 cup) of distilled water,

Part A: Baking soda into washing soda (sodium carbonate)

$$2NaHCO_3 \Rightarrow Na_2CO_3 + CO_2 + H_2O$$

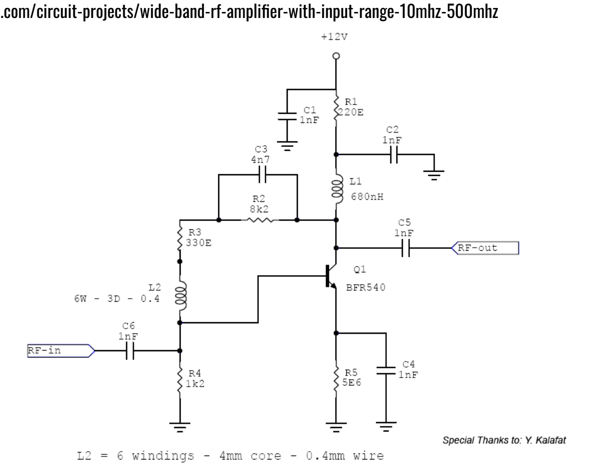
Heating sodium bicarbonate to carbonate removes hydrogen, oxygen and some carbon.
1rsthr 500g 150F (65C) **2ndhr** 250F (120C) **3rdhr** 350F (175C) **4thhr.** 450F (230C) **Step 5.** Cool.

Part B: Na_2CO_3 and Potassium Bitartrate into Rochelle salt $NaKC_4H_4O_6$

Step 1. 200 grams (7 oz) cream of tartar into 1 cup distilled water. Stir. **Step 2.** Put cup into saucepan filled inch high with water **Step 3**. Heat till simmer. Stir **Step 4**. Add ½ tsp (2.5 ml) sodium carbonate bubbles up. Stir **Step 5.** Repeat Step 4, upto 50 minutes until no more bubbles on add. During the last few times the solution will be clear with a yellowish tint. Stir it vigorously for a minute anyway to be sure it's ready. I've found it may still bubble but just takes longer to do so. **Step 6.** Pour hot solution through a coffee filter, be patient. The key word in the above paragraph is "hot". Liquid will cool to crystal in filter when taking too long. Set liquid crystal hot, else reheat. **Step 7**. Heat the filtered solution, evaporating away some water. Use measuring marks. **Step 8.** Cool several days. Crystals faster in cool area. **Step 9.** You can make crystals as large as 3/8" (1 centimeter) long. Pick one of the ones you've made and use it as a seed crystal to grow a larger one around it. See my page on how to test rochelle salt crystals for more about this. **rimstar.org/materials/piezo/rochelle1.htm**

Wide Band RF Amplifier Input Range 10MHz - 500MHz

eeweb.com/circuit-projects/wide-band-rf-amplifier-with-input-range-10mhz-500mhz



1 henry (H) is equal to 1000000 microhenry (μH), or 1000000000 nanohenry (nH)